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ABSTRACT

Primarily a feasibility study, the research reported is based on Eysenck's hypothesis that conditionability is a unitary factor related to introversion-extroversion and attention span. Thirty infants, representing a random sampling of race, sex, and socioeconomic background, were tested on three consecutive days at ages 3 months, 5 months, 9 months, and 12 months. Tests based on existing methods of successful infant conditioning were adapted to infants' abilities at each age, but at each test time included eye blink, vocalization, head turn, discrimination and single-stimulus conditioning. Tests of attention-span and the Bayley Test of Mental and Motor Development were also given each time. The subjects will be tested again at age 3 and at age 7, using standard IQ and personality tests. The feasibility of this longitudinal study was established, and conclusions were drawn about the usefulness of the various conditioning procedures employed. Further research leading to standardized procedures and a test of conditionability is needed, to give clues to the child's individual learning style. Figures showing the apparatus for the tests used in this study are included. (Author/NH)

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FINAL REPORT

Project No. 9-D-049

Grant No. OEG-4-70-0004 (057)

CONDITIONING TASKS PERFORMANCE IN INFANCY AND EARLY CHILDHOOD AS A STABLE AND MEASURABLE ASPECT OF BEHAVIOR

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SUMMARY

Tests of conditionability in infants were used in a longitudinal study of thirty subjects in the first year of life. Thirty S's, representing a random sampling of infants of both races, sexes, and diverse socio-economic backgrounds, were tested on three consecutive days at ages 3 months, 5 months, 9 months and 12 months. Tests based on existing methods of successful infant conditioning were adapted to infants' abilities at each age, but at each test time included eye blink, vocalization, head turn, discrimination and single-stimulus conditioning. Tests of attention-span and the Bayley Test of Mental and Motor Development were given at each test time.

The S's will be tested again at age 3 and at age 7, using standard I.Q. and Personality tests.

Primarily a feasibility study, the research is based on Eysenck's hypothesis that conditionability is a unitary factor related to introversion-extroversion and attention span.

The feasibility of a longitudinal study of 30 S's, administering 3-5 tests of conditionability at each test session was established. Various conditioning procedures were used and conclusions drawn about their practicability, aversiveness, timing, ease of administering and measurability. It is hoped that further research will lead to more standardized procedures and eventually to a standardized test of conditionability.

INTRODUCTION

This research was initiated by a series of hypotheses suggested by H. J. Eysenck[1/] which are discussed at length in Biological Roots of Personality[2/] and in other of his writings. A partial summary of Eysenck's hypotheses follows:

> There are two basic dimensions of temperament or personality which may be called the dimension of introversion-extroversion and the dimension of emotionality. These dimensions are hereditary, but like all human attributes, may be modified by "environment" to produce a phenotype which differs from the genotype. Nevertheless, these are strong hereditary predispositions and are relatively unmalleable.
>
> The dimension of introversion-extroversion is linked to a number of other aspects of behavior in addition to the obvious one of being outgoing as opposed to withdrawn. These include attention span (longer for introverts); threshold of tolerance for stimuli (extroverts endure and seek more intense stimuli); and learning style (introverts condition faster and extinguish later).
>
> Basic temperamental introversion-extroversion predicts the individual's facility in being conditioned to observe moral and other behavioral norms (extroverts are more likely to become juvenile delinquents). Basic temperamental introversion-extroversion indicates a best teaching strategy in conditioned learning (extroverts require more repetitions using a stronger stimuli but in shorter conditioning sessions).

1/ Eysenck, H. J., Ph.D., D Sc., Professor of Psychology, University of London; Director, Psychological Laboratories, Institute of Psychiatry, London, England.

2/ Eysenck, H. J. Biological Roots of Personality. Boston: Houghton Mifflin Co., 1967.

Eysenck, H. J. Crime and Personality. Boston: Houghton Mifflin Co., 1964.

The clear implication that there are wide individual differences in conditioning behavior in children and, therefore, that wide individual differences in teaching strategies are indicated seemed to the investigators a premise worth following up in empirical investigation. It seemed reasonable to assume that:

(1) While the personality dimension of introversion-extroversion is difficult to test in early infancy, conditioning performance can be tested. The literature is replete with accounts of successful infant conditioning.3/

(2) The possible effects of a hereditary predisposition would be greatest at an early age, indicating the desirability of testing during the first year of life. Therefore, the objective of the investigators was to devise a battery of conditioning tasks applicable at ages 3 months, 6 months, 9 months, and 12 months which would examine

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3/ Brackbill, Yvonne, "Research and Clinical Work with Children," in Some Views on Soviet Psychology, ed. by R. Bauer. Washington, D.C.: American Psychological Assn., 1962.

Brackbill, Yvonne and Koltsova, M. M., "Conditioning and Learning," in Infancy and Early Childhood, ed. by Yvonne Brackbill. New York: The Free Press, 1967.

Bijou, Sidney W., and Sturgis, Persis T., "Positive Reinforcers for Experimental Studies with Children - Consumables and Manipulables." Child Development, 1959, 30, 151-170.

Gormezano, "Classical Conditioning," in Experimental Methods and Instrumentation in Psychology, ed. by Joseph B. Sidowski. New York: McGraw Hill, 1966.

Sandys, James, "Operant Conditioning," Ibid.

Bair, B. S., "Operant Methods in Child Behavior and Development," in Child Development: Readings in Experimental Analysis, ed. by Sidney W. Bijou and Donald M. Baer. New York: Appleton, Century, Crofts, 1967.

Lipsitt, Lewis P., "Learning in the First Year of Life," in Advances in Child Development and Behavior, ed. by Lewis P. Lipsitt and Charles C. Spiker. New York: Academic Press, 1963.

individual differences and patterning in conditioning behavior. In addition, attention span and general mental and motor development would be examined to see if conditionability was related to any of these. As part of this study the same subjects would be tested at 3 years of age, using a standardized test of I.Q., and at 5 years of age using a standardized test of introversion-extroversion, to see if early conditionability predicted a later measurement on either of these tests.

The focus of this project is on the presence or absence of stable individual differences in patterns of acquisition of learned (i.e., conditioned) behaviors.

The investigators do not consider that this research is primarily a study of whether infants <u>can</u> be conditioned. Infants have been successfully conditioned in all the basic ways the researchers have used. Nor is it a primary concern to explain what process is at work in the kind of head turn conditioning which involves a CS, a UCS and a reinforcement.

Since the tasks have included more operant procedures than classical conditioning procedures, the question may be raised as to whether Eysenck's theoretical construct applies to operant conditioning. In a letter to the investigators, Eysenck said,

> Other things being equal I would expect operant conditioning to be stronger in introverts, provided drive stimuli were not too strong. The difficulty that arises lies in the nature of reinforcement; if this is given by a person, e.g., in verbal conditioning, then this reinforcement may be stronger for extroverts, who like people, than for introverts, who don't.[4/]

In any case, there are few kinds of non-aversive classical conditioning procedures possible at age three months and beyond. The conditioning tasks have been considered simple learning tasks involving various degrees of voluntary reflective response.

4/ Letter to the investigators, September 13, 1968.

METHOD

General

The method set forth in the grant application has been carried out with one exception--the original plan called for only fifteen subjects. It was possible to double the number of experimental subjects. Thirty-two subjects were recruited. All births in the city hospital during the period from July 15 to September 15, 1969, were recorded on file cards. The names were drawn in random order from four stacks so that the final sampling included: white males, white females, black males, black females. Parents of these babies were contacted by telephone and, in cases where there was no telephone, by personal visits. One subject was lost during the first test period (at age three months) because the family left the city. One subject moved 750 miles away in June, 1970, but was tested on schedule at the 12 month age. In addition to the thirty-one experimental subjects, ten control subjects were given the same battery of conditioning tasks at age one year to check for test-familiarity effects.

Each infant was brought in by the mother for three successive mornings at each test period. No compensation was available, but transportation was furnished if the family had no car, which made it possible to keep a number of low income infants in the project. The mother and infant were always welcomed and made to feel that they were making a worthwhile contribution. The first five minutes of each test period was devoted to free play and social interchange with the mother and infant by the examiner.

At each test period the following procedures were observed. The infant was given four conditioning tasks which were usually repeated on each of three days. At each test period the Bayley Test of Mental and Motor Development was administered, a simple test of attention span was carried out, and the mother was given a questionnaire to fill out and return. Insofar as possible, the investigators tried to use conditioning tasks already reported in the literature and already successfully used with infants. Criteria for accepting conditioning tasks were: Is it appropriate for the age? Is is simple to administer? Is it non-aversive to most babies? Can a reasonable number of babies reach criterion performance? Can the investigators get the necessary equipment within the very limited budget assigned for equipment and electrical engineering help?

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Conditioning tasks were devised and accepted in the following four categories: eye blink, head turning, vocalization, and simple discrimination. At some age periods, a Skinner-box type task of simple operant conditioning was added.

The general design of the test room, which is in itself an important item, went through three phases during the year. In Phase I (age 3 months) a vacant room was used with minimal and very crude instrumentation, which was visible at all times. The infant either lay in a crib or was propped up in an infant seat or, if necessary, was held in the mother's lap. The examiner, recorders, and observers were present in the room.

In Phase II (ages 6 months and 9 months), acting on suggestions from our consultant, Dr. Herbert Kay, distracting stimuli were blocked out by building a series of test cubicles, each separately wired and curtained off and the whole room painted white. While this layout looked more professional and did aid in eliminating distractions, it was aversive to the subjects.

In Phase III (age 12 months) a new room with an entirely different layout was used. It had as much of the test machinery as possible back of a barrier wall, and was more pleasant in appearance and gave more freedom. Observers were stationed behind the baffle wall and viewed the testing through a one-way mirror. The room was approximately 10 feet square, had air conditioning and a soft rug so that the baby could crawl or walk freely. The mother sat in a chair in the room which seemed to make the subjects feel more secure. The Bayley test was administered in a different room, furnished only with a small table for administering the test and chairs for mother and examiner and two cribs which could be used for sleepy infants.

Setting Factors

Control of variables involved making decisions on many points. In each case the value of keeping the child happy enough to complete testing had to be weighed against the value of keeping procedures uniform. The value of modifying procedures to accommodate individual differences had to be weighed against the value of uniform procedures; e.g., the infants' toleration of noise varied so that some children responded well only to a loud noise while others could not tolerate a loud noise. Was it better to keep a moderately loud noise, thus eliminating the children at the extremes of noise tolerance? Or was it better to accommodate the noise

level to the child's tolerance level in order to maximize the chance of getting data on each subject's conditioning rate? In general, the experimenters felt that since a focus of concern in this research was individual differences, the noise level should be lowered until it could be tolerated by the child but a record kept of these changes. A consistent difference was found in the subjects' ability to tolerate confinement, noise, strangers, absence from mother, an approaching object, prolonged testing, and many more attributes. In general, the investigators tried to accommodate procedures to the most sensitive subjects.

Other decisions involved:

What criteria of behavior would determine when a child was sufficiently awake and happy to be "testable"? What criteria would determine when a child's test period should be terminated because of restlessness, illness, sleepiness or evident unhappiness?

If the subject resisted being placed in a jump seat or infant seat, under what circumstances would he be put in the mother's or experimenter's lap? Generally, the subject was placed in the seat and the situation changed when necessary to facilitate the child's continuation in the testing. In cases where the situation had to be changed, this fact was noted. It was felt that this type of comment contributed to an understanding of the child's total learning pattern.

While the investigators were able to make some general observations about the effectiveness of different reinforcers for the group as a whole, some of the subjects were clearly uninterested in reinforcers which were effective with others. When the reinforcer planned for a given conditioning procedure was clearly aversive for a given subject, the reinforcer was changed. Again, the overriding consideration was considered to be that of exploring fully the range of individual differences which affect teaching strategies.

Some subjects were indifferent to the presence of the mother and some were untestable without the mother at the three and six month level but all 31 experimental and nine of the ten control subjects needed the presence of their mother or a mother substitute at the twelve month level. The policy was to have the mother present but seated quietly and unobtrusively to one side throughout testing.

PROCEDURE

The general procedure was to make a tentative list of test equipment for each period and then to solicit the help of graduate students in Electrical Engineering to advise with the investigators on what could be done. Some of the equipment was built in the Electrical Shop and some in the Electrical Engineering Laboratory at the University of Alabama. As some of the equipment was completed, three to six pilot subjects were brought in and procedures for each task were revised. It was necessary to modify some procedures and to modify, throw out and/or rebuild some equipment. The process of designing, building, pilot testing, revising and deciding on final procedures was repeated four times during the year. The steps for each conditioning task as well as the general program for each day were posted prominently on the walls for each test period.

At each test period, subjects were scheduled for testing over an 8 weeks period. Two were scheduled for Monday through Wednesday mornings and two more subjects for Wednesday through Friday mornings, making Wednesdays a double load day.

Three people, plus a Bayley tester who was present on three days each week, were considered a full testing staff. Most of the time one or more additional staff members were present to answer the telephone, transport subjects and deal with waiting mothers.

The following section gives a description of procedures used at each test period with comments about the feasibility of each. (See Schedule of Procedures, Appendix A, for procedures on each day for the test periods.)

Three Months

Eye blink.--The infant was placed prone in a crib with a plexiglass shield over his face. A hand buzzer was sounded by the examiner at 3 second intervals until the subject failed to blink to five consecutive tones. Then the tone was synchronized with the release of muslin parachute held by another examiner. After three pairings of tone and drop, the tone alone was sounded and blinks to these "probe" trials of tone alone were recorded. Five blinks out of 10 probes were considered criterion. If criterion was reached, extinction procedure was carried out. This task was repeated each day for three days.

Eye blink conditioning using parachute and buzzer was easy to use, easy to tally and not aversive to most subjects. Eye blink procedures throughout were suggested by, but not identical with, those of Burton T. White.5/

Vocalization.--The infant was placed prone in a crib with only the examiner visible to the infant. Three minutes of unreinforced vocalization were recorded, followed by three minutes of social reinforcement during which the examiner smiled and said, "Good boy," every time the infant vocalized.

Vocalization procedures were adapted from Rheingold.6/ This procedure was carried on twice a day for three days with the last trial on the third day being nonreinforced.

Head turn.--The examiner was seated in a chair holding the infant on her lap so that the infant faced a blank wall. A screen blocked distractions on three sides. Door chimes which were sounded for one second were used as a cue and sucking on a bottle of milk for three seconds if the infant turned right was used as reinforcement. Ten trials were used on each of three days. If the infant met criterion of five correct head turns, the reinforced side was changed to the left side. If criterion was met on this side, an extinguishing trial was administered.

5/ White, Burton T., "Child Development Research: An Edifice Without a Foundation," Merrill-Palmer Quarterly, 1969, 15, 51-79.

White, Burton T., and Riley, Kitty, "An Apparatus for Eliciting and Recording the Eyeblink Response in Human Infants." Unpublished manuscript.

6/ Rheingold, Harriet L., Gewirtz, Jacob L., and Ross, Helen W., "Social Conditioning of Vocalizations in the Infant," in Child Development: Readings in Experimental Analysis, ed. by Sidney W. Bijou and Donald M. Baer. New York: Appleton-Century-Crofts, 1967, pp. 47-58.

This procedure was tolerated by most subjects but subject had to be neither hungry nor satiated. Head turn procedure was suggested by the work of Papousek.7/

Discrimination box.--The infant was placed prone in a crib with a plywood box covering half of the crib. Two lights in the top of the box were wired so that either could be activated, lighting a clown's face. The examiner peered through a ½ inch hole in the top to determine to which light the infant's gaze was directed. Looking at one of the lights resulted in its being activated but looking at the other had no effect. This device was suggested by John Watson's work.8/ The subjects would not tolerate this device.

Attention span.--The subject was placed prone in a crib. The examiner held a 4" red ring 10" above his face while two observers stationed at either side of the crib clocked the amount of time subject focused on the ring. The same procedure was used with a 12 x 16 inch mirror held over his face and also with the examiner bending over until her face was 10" about subject's face.

Six Months

Eye blink.--As indicated in Figure 1, the subject was placed prone in a crib with a plexiglass shield over his face. A tone produced by an oscillator was sounded until the subject failed to blink to five consecutive tones. Then the tone was synchronized with the release of a muslin parachute suspended from a mechanical micro-switch apparatus over the subject's face. The drops were programmed by a punched tape and averaged 2-3 seconds apart. After three pairing of tone and drop, the tone alone was sounded and blinks to these "probe" trials of tone alone were recorded. Five blinks out of 10 probes were considered criterion.

7/ Papousek, Hanus, "Appetitional Behavior in Human Infants," in Early Behavior, ed. by Harold W. Stevenson, Eckhard H. Hess, and Harriett L. Rheingold. New York: John Wiley and Sons, Inc., 1967, p. 270.

8/ Watson, John S., "Memory and 'Contingency Analysis' in Infant Learning," Merrill-Palmer Quarterly, 1967, 13, p. 58.

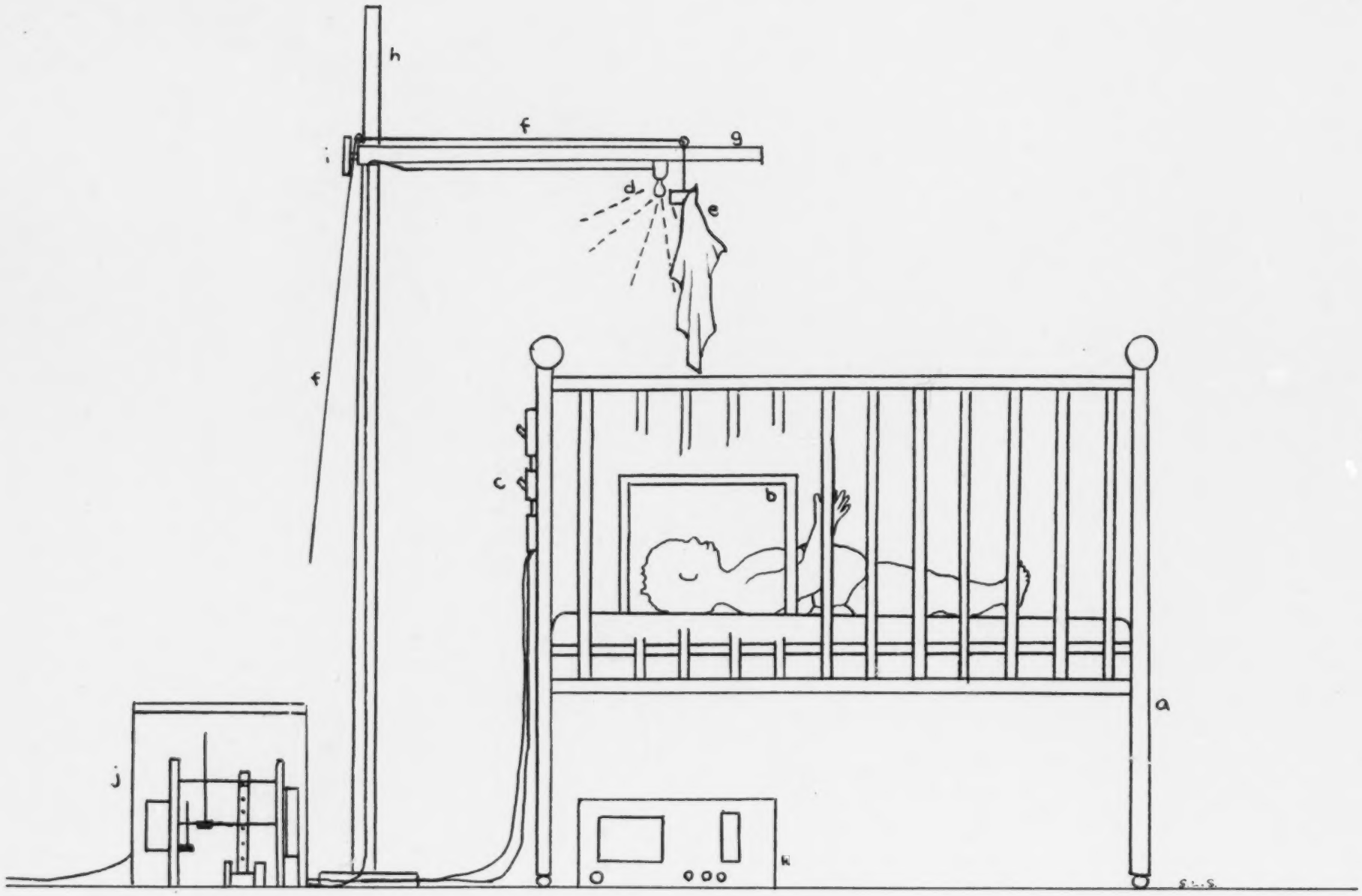


FIG. 1. Eye blink conditioning apparatus using "parachute" drop.

Figure 1

a. crib
b. table with plexiglas top
c. control panel
d. light source
e. handkerchief with weight
f. string
g. support arm
h. pole for support arm
i. handle for adjusting height of support arm
j. tape punched to program randomly spaced rings and drops
k. oscillator sound source

Eye blink conditioning was not aversive under these conditions:

ITI less than 5 seconds.
Machine drop with buzzer soft in tone.
Subject not placed in anything which resembles a box, so that subject is able to look out during this acquisition (this does not interfere with acquisition of blink and adds to his tolerance of the procedure).

Vocalization.--The infant was placed in a playpen with a favorite toy in a completely bare room by himself for three minutes for unreinforced vocalization. Two observers tallied his vocalizations from an adjoining room. On Day I, following the unreinforced period, vocalization was reinforced for 3 minutes with each of these:

sound reinforcement as at 3 months
mirror
music box
manipulative toy

At six months, the subjects seemed to be interested in the mirror, music box, and a manipulative toy, but not in social reinforcement.

Head turn.--The subject faced a semicircular screen (see Figure 2) when he turned his head to the left a picture was projected on the screen to his left, slowly moved to center and was then turned off. Every left turn was rewarded by a rotating picture. An arrangement of photoelectric beams behind the child's head was rigged to record the turns on an Esterline Angus Recorder. However, every attempt to affix an object that would be light in weight and which would extend out from the child's head to intercept the beam was unsatisfactory. The most satisfactory arrangement was having two observers to record right and left head turns.

Using head turns in a purely operant design at six months was practical under these conditions:

Infant seated in a walker.
Reinforcement immediate exposure of 1 (not 4) colored slide which promptly moved to a direct front position in order to reinforce the next head turn. If return to 'start' position was

delayed as much as 3-5 seconds, the delayed reinforcement was aversive and frustrating. Child satiated usually in 3-6 minutes. Measurement of head turns was complex at this age, and the investigators are still checking out intercepted beam device. (See Figure 2.)

Cube discrimination.--Ten trials with two colored cubes were used. The yellow cube was sugar coated while the red cube was uncoated and glued to the tray. The position of the cubes were reversed for each trial. The tray was removed from the subject's left and always reappeared from the right. The subject was seated in a jump seat in a cubicle with a curtain in front. The experimenter sat in a low chair in front of the subject to present the tray which was handed through the curtain. The subject was allowed to chew the sugar cube for 3 seconds when this one was picked up. Two observers recorded which cube he reached for first on each trial.

This was easy to administer and tally and well liked by most of the six month olds. One similar task proved less effective--colored cloths, one of which was soaked in a sweet solution. The task was inspired by work with Ling using colored cloths.9/

Attention span.--The subject was seated on his mother's lap in a plyboard box 4' by 4'. The front door contained a one way mirror through which two observers clocked the number of seconds until subjects focused on the object which was lowered through a trap door in the top and the amount of time he fixated on the object. The objects were (in order of appearance): a small lighted head of a mouse, a mask, and a metronome. (See Figure 3.)

Unexpected Findings at Six Months

Laugh response.--Some babies laughed when a parachute suspended over the face was dropped. This instigated a study to identify several categories of stimuli which elicit audible laughter, including a study of how mothers make their babies laugh.

9/ Ling, B. C., "Form Discrimination as a Learning Cue in Infants." Comparative Pschological Monographs, 1941, 17, No. 2, 66.

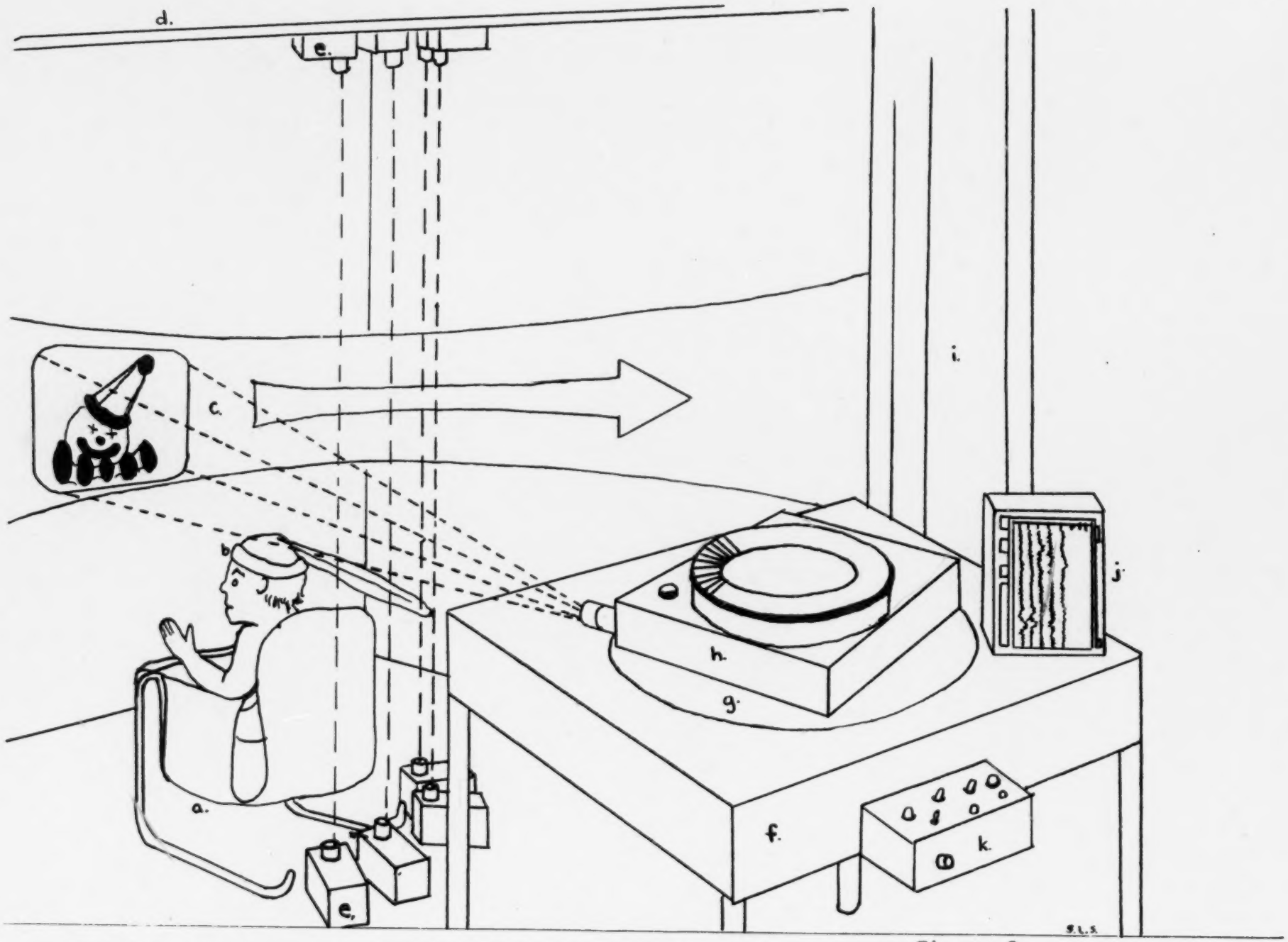


FIG. 2. Head turn apparatus using rotating slide projector.

Figure 2

a. infant seat
b. cap and feather to interrupt photo electric cells
c. curved viewing surface
d board supporting cells
e. photo electric relay systems
f. table
g turn table
h. picture projector
i. curtain to close off room
j. Esterline-Angus recorder
k. control panel

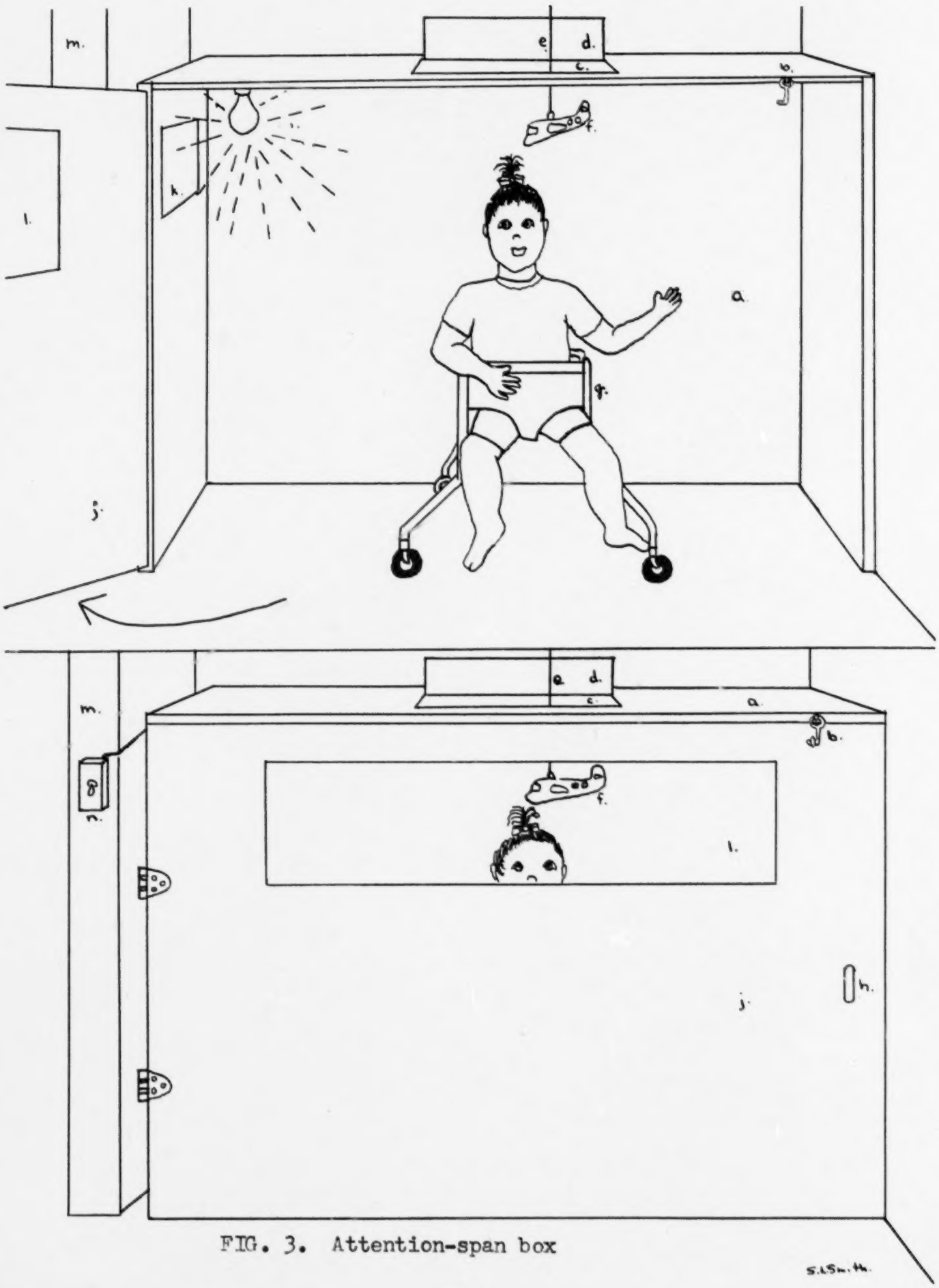


FIG. 3. Attention-span box

S.I.Sm.th.

a. large box
b. latch
c. hole in ceiling
d. trap door
e. string from toy to observer's hand
f. toy
g. infant seat
h. handle
i. light source
j. door
k. oneway mirror with window in barrier wall
l. second one way mirror
m. barrier wall
n. light control

Right-hand reach at age six months.--Subjects show a clear preference for reaching with the right hand and for an object on the right side rather than on the left side. Only one subject made an initial reach to the left and this infant was said by the mother to be definitely left-handed.

Nine Months

Eye blink.--Same procedure as at 6 months (see Figure 1).

Two strong disadvantages of this mechanical programmed procedure at the nine months period were: (1) subjects objected to being restrained in a prone position and (2) it was necessary to keep subject's attention fixed on the glass. The timing of the drops and tones was, therefore, often accomplished more efficiently by manual control of the tone-drop sequence than by mechanical control.

Head turn.--The head turn procedures were the same for nine months as 6 months.

Most subjects objected to being separated from their mothers and being placed in a cubicle facing away from the room. It is possible that this procedure was too mature for the nine-months-old, as some pilot subjects fourteen and fifteen months old performed satisfactorily in a later test.

Vocalization.--A baseline rate for unreinforced vocalization was recorded for 3 minutes on the first day. This was followed by reinforced vocalizations for 12 minutes. Reinforcements used were: social reinforcement, mirror reinforcement, music box reinforcement and food (Cheerio) reinforcement (three minutes each).

Vocalization involves a minimum of instrumentation but a maximum of recorder decisions. Defining readiness to be tested, a unit of vocalization, and the kinds of vocalization to be tallied were complicated decisions. Whines, cries, laughs or grunts were not considered vocalizations. A sensitive microphone and tape recorder are helpful in obtaining reliable data.

One panel press box.--The subject was seated in a playpen facing a 12 x 15 inch wooden box (see Figure 4a). In the center of the box surface facing the subject, a colored cellophane clown's face was affixed to a milk glass panel (8 x 10 inches). When the panel was pressed, a light inside the box turned on, lighting the clown's face. The press also triggered a door chime which made a pleasant two-tone chime sound. The subject was introduced to the box by the Experimenter who demonstrated the press motion 3 times. Thereafter, the Experimenter tapped but did not press the panel. The box was wired to an Esterline Angus Recorder to record press rate. The total number of successful presses in a three minute interval were also hand tallied. This was a simple reinforcement procedure similar to a Skinner box and well liked by most all the subjects.

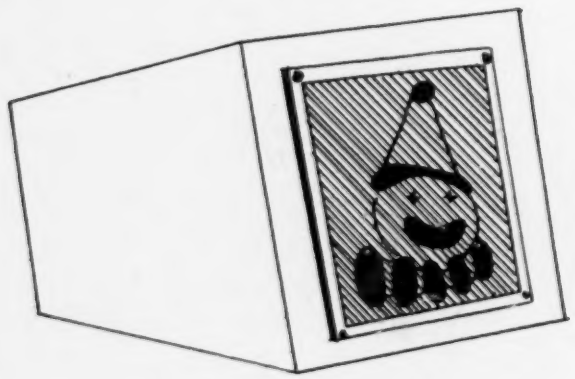
Ring discrimination.--The subject, seated on his mother's lap, was placed in front of two four inch plastic rings suspended from a wooden frame. If the child grasped the left (red) ring, a light directly in front of him turned on and simultaneously a tune played on a music box. Grasping the right (blue) ring was not reinforced. The child was given ten opportunities to grasp a ring as two observers recorded which ring was grasped first on each trial. Five successive reaches to the left (red) ring was considered criterion. This was a simple discrimination problem inspired by Friedlander[10/] who used two lamps as reinforcement. It was easy to administer, non-aversive, and suitable for the nine month age.

Attention span.--The subjects were placed in a walker, in the enclosed box used for the six month test and the same procedure adopted for this age with the attention span objects being changed. For this age, in order of use, a 4" hand bell, a 6" doll, and a red and yellow plastic camel (moving) were presented.

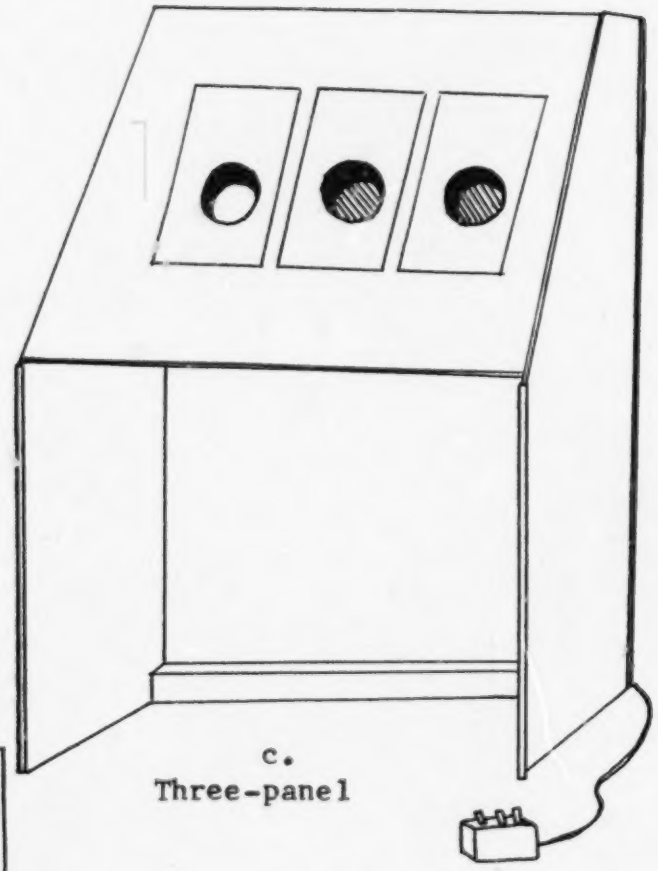
Twelve Months

See Figure 5 for a diagram of the test room.

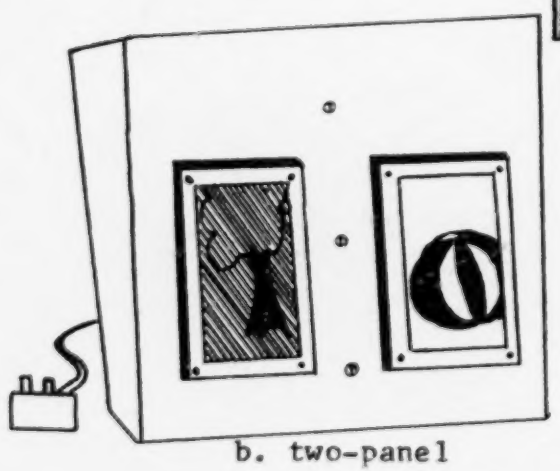
10/ Friedlander, B. Z., "Automated Measurement of Differential Operant Performance," in Advances in Child Development and Behavior, ed. by Lewis P. Lipsitt and C. C. Spiker. New York: Academic Press, 1963, p. 186.



a. One-panel



c. Three-panel



b. two-panel

FIG. 4. Panel press boxes of increasing complexity

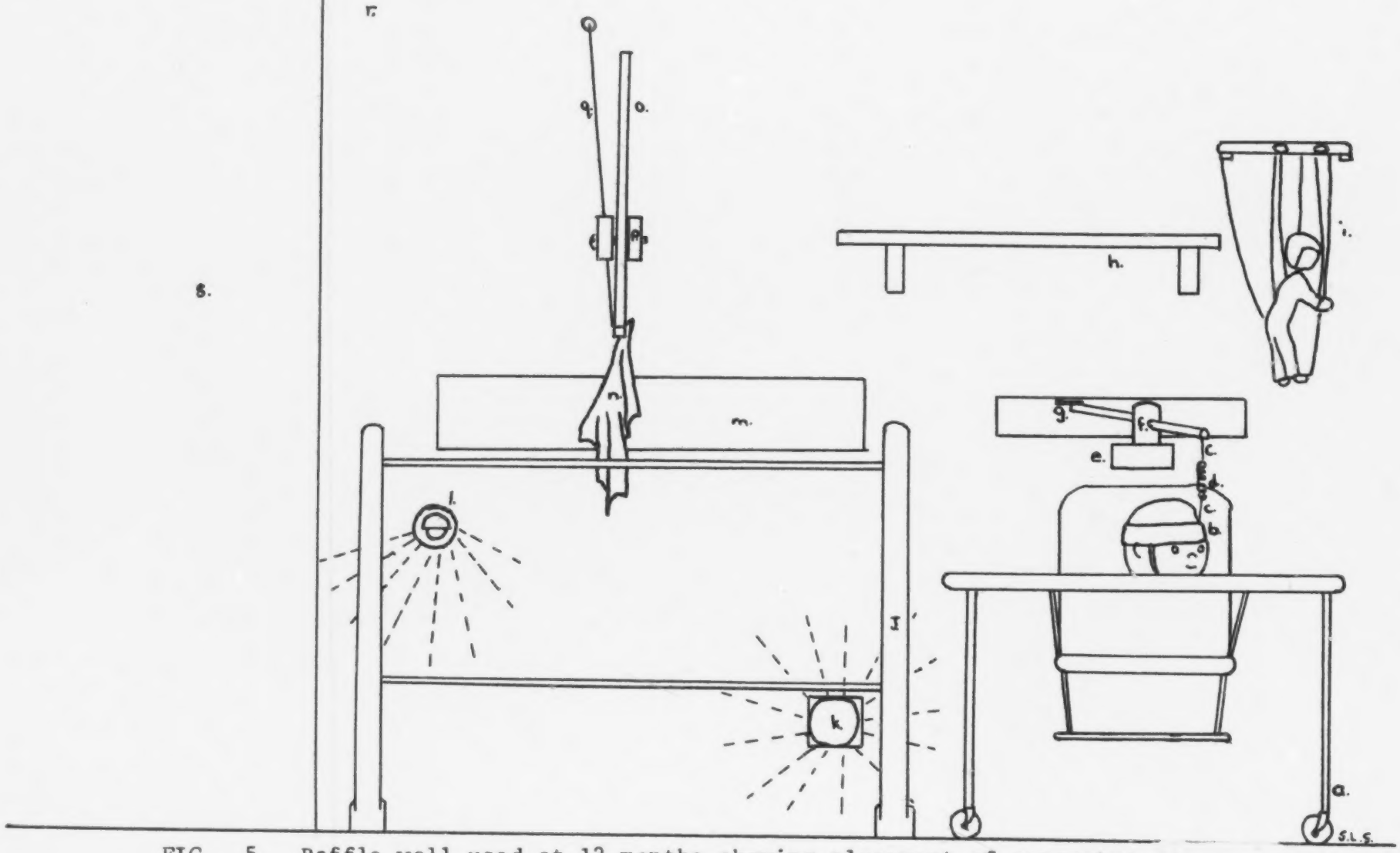


FIG. 5. Baffle wall used at 12 months showing placement of apparatus.

a. infant seat and table
b. headband and chinstrap
c. string
d. spring
e. pivot block
f. swinging arm
g. plate for interuption of cells
h. shelf for toys
i. doll for head turn experiment
j. plexiglass screen
k. sound source
l. Light source
m. oneway mirror
n. handkerchief
o. swinging arm
p. moveable supportarm
q. string
r. barrier wall
s. door to control room (baby seat and three-sided screen not shown.)

Eye blink.--Eye blink conditioning was used on each day for three consecutive days. The subject was seated in a jump seat facing a plexiglass shield on a stand (see Figures 5 and 6). A 450 Hertz Sine-ware tone, controlled by an oscillator, was sounded for 1 second at 2-3 second intervals until the subject failed to blink five times consecutively to the tone alone. Then the tone was synchronized with the drop of a red parachute affixed to a vertical moving wooden arm and with the turning on of a light (25 watts). Three parachute drops were presented with this synchrozization and then the tone alone was sounded. This sequence was followed for 10 trials (thirty pairings and ten probes). Blinks on the probe trials were recorded by an observer viewing through the one-way mirror and the examiner who was present in the room with the subject.

Several problems were encountered with this conditioning task. One was keeping the child's gaze straight ahead on the plexiglass shield. The experimenter tried tying a small bright toy behind the shield and placing an examiner behind the glass facing the subject. The light was the most successful of these attention-getting devices. A second problem was that many children resisted any task which involved enforced sitting. Other problems were that many subjects tired of the task before completion and some subjects found the procedure aversive. An optional but more successful technique was introduced which was a hand puppet tapping on the plexiglass at the sound of the buzzer.

Head turn.--The subject was seated in a baby-tenda seat facing a screen about four feet high (see Figures 5 and 7). When a buzzer sounded the child's gaze was attracted to the left side of the screen. Immediately after he turned left, a marionette was introduced at left and made to walk to the center of the table, where he raised his hand and was made to say "That's good, _____." The marionette then disappeared over the screen at center position and the experimenter asked "Where did he go?" When the buzzer sounded again, the experimenter waited for ten seconds for a spontaneous turn. If a spontaneous turn occurred, the marionette appeared. If not, the experimenter attracted the subject's attention to the left and then introduced the marionette. The marionette was not introduced on the third day if there was no spontaneous turn. Spontaneous right and left turns by subject after the buzzer were tallied. Ten buzzes constituted one session and the procedure was repeated each day for three days. Five out of ten consecutive left turns constituted criterion. If criterion was reached, the reinforced side was changed from left to right.

An effort was made to record head turns instrumentally (see Figure 7). A metal arm on a bearing was affixed to the barrier wall over the child's head. The metal arm extended to a circle of photo electric beams behind the wall which recorded turns of 30 and 45 degrees to the right or the left. The design called for placing a soft headband around the subject's head with a piece of strong nylon fishline connecting the headband to the moving arm. Since the subjects resisted wearing the headband, other methods were tried, included attaching the string to a bandaid on the subject's head and attaching the string to a small bow or beret in the subject's hair. None of these methods were amenable to the subjects so this remained an unsolved problem. Using the buzzer as a cue to turn left seemed to be an alerting signal which facilitated conditioning and simplified tallying.

Vocalization.--Vocalizations were tallied on two days. On Day I, three minutes of nonreinforced vocalization would be recorded to get a baseline rate. This was followed by social reinforcement using a monkey hand puppet and by food (Cheerio) reinforcement. On Day II, the procedure was the same as on Day I, and, in addition, music box reinforcement was introduced.

Two panel press box.--The Two Panel Press Box is an adaptation of a procedure used by Lipsitt and Simmons.[11/] For this task, on Day I, the subject was seated on the floor facing a 15 inch square wooden box. (See Figure 4b.) On the face of the box nearest the child were two six by eight inch milk glass panels which covered color transparancies of appropriate pictures (ball and dwarf). A remote control switch enabled the experimenter to activate either panel. When the right hand panel was active a right hand press triggered lighting up of the right picture. The experimenter first pressed each panel three times to demonstrate that one was active and one was not. Then the child's hand was placed on each panel and pressed three times. The subject's presses were tallied over a three minute

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11/ Simmons, M. W., and Lipsitt, L. P., "An Operant-Discrimination Apparatus for Infants," Journal of Experimental Analytical Behavior, 1961, 4, 233-235.

Simmons, M. W., "3 Panel Press Box," in Advances in Child Development and Behavior, ed. by Lewis P. Lipsitt. New York: Academic Press, 1963, p. 181.

Fenster C. B., and DeMyer, Marian K., "A Method for the Experimental Analysis of the Behavior of Artistic Children," American Journal of Orthopsychiatry.

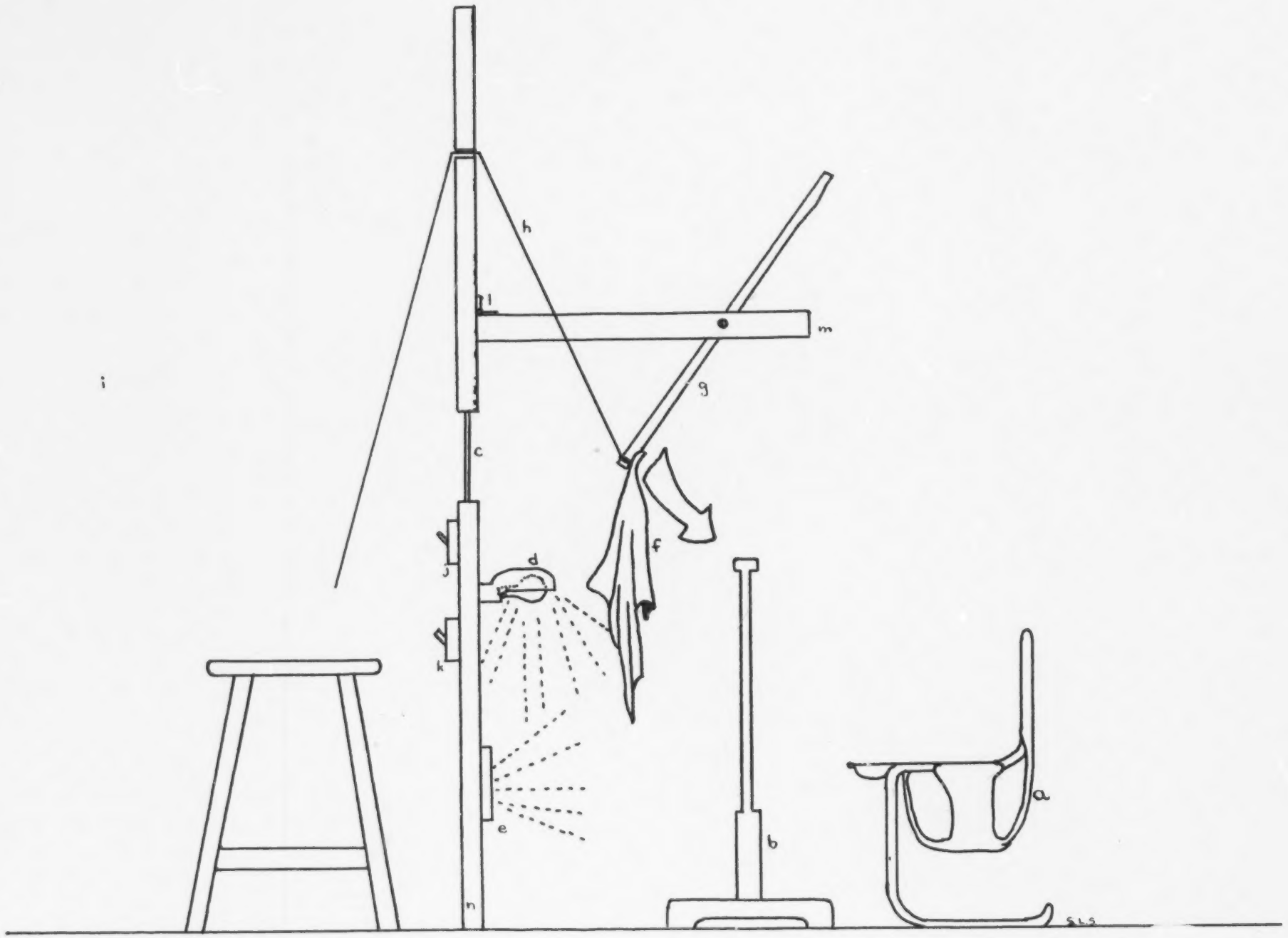

FIG. 6. Baffle wall, cross section, eye blink apparatus.

a. infont seat
b. plexiglas screen
c one way mirror
d light source
e. sound source
f. handkerchief
g. moveable arm
h. string
i. control room
j. switch for sound
k switch for light
l. hinge
m. moveable support arm
n. barriar wall

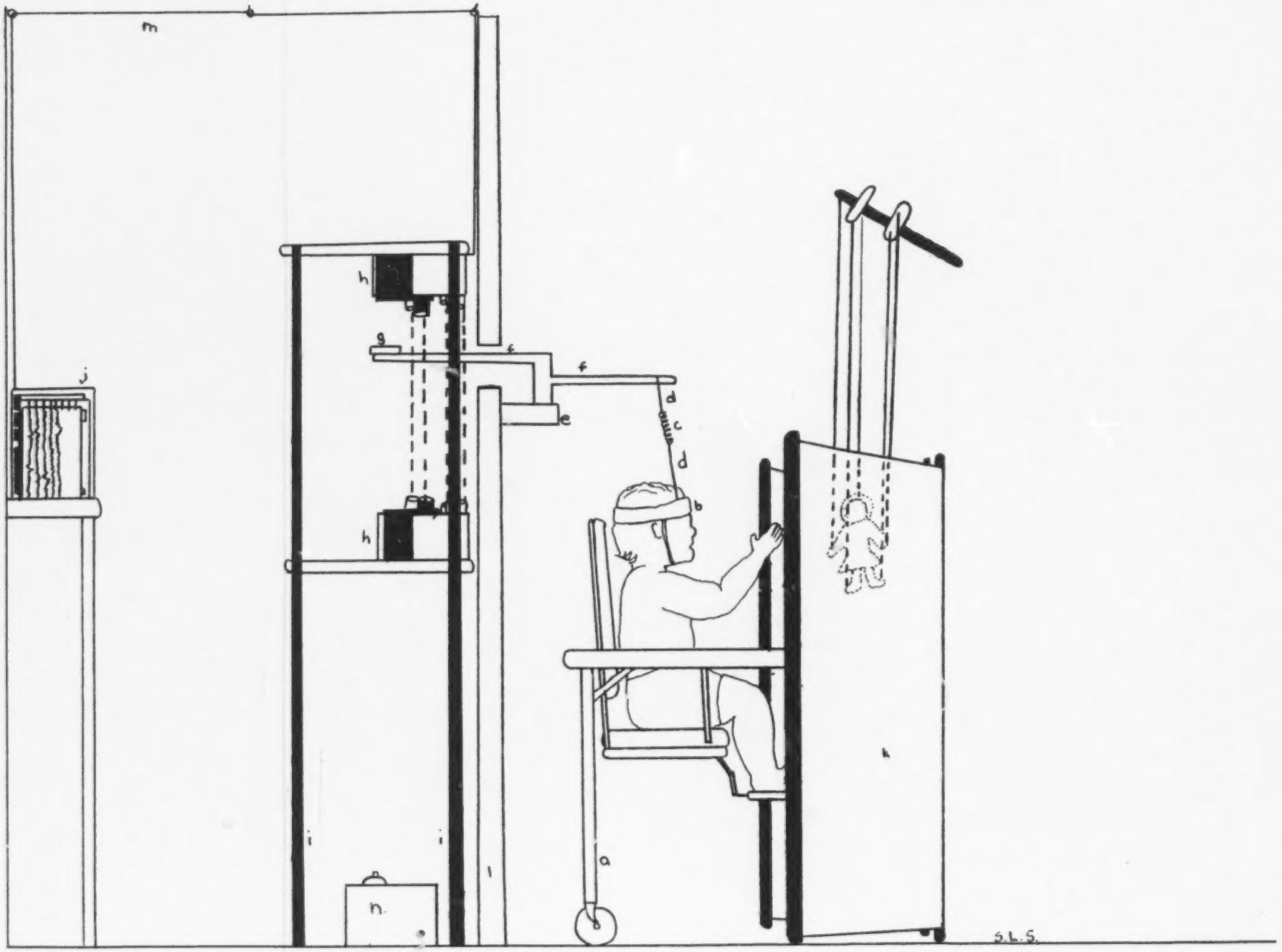

FIG. 7. Cross section view of head turn apparatus.

a. infant seat and table
b. chinstrap and headband
c. spring
d. string
e. pivot block holding bearing
f. swinging bar
g. plate for interrupting cells
h. photo electric relay systems
i. poles supporting cells
j. Esterline-Angus recorder
k. screen
l. barriar wall
m. wires for cells and recorder
n. buzzer in box

period by a wire to the Esterline Angus Recorder which recorded right and left presses. Five consecutive presses of the reinforced side were considered criterion and the R-plus side was changed by the remote control switch. The panel box was non-aversive, simple to administer and interesting to most subjects.

The WGTA.--This procedure, modeled on that described by Weisburg,[12] is a discrimination problem. The WGTA box contains a pull-out shelf with two holes, each with a sliding cover. The reinforced hole was marked by a small red heart affixed to a wooden block behind the hole. The experimenter sat behind the box and raised a front door which enabled the subject to get to the covered holes, one of which contained a checker. The mother held the subject on her lap and further reinforced finding the checker by saying "There it is!" when the subject opened the correct hole. After each trial, the experimenter lowered the door to put another checker in place. When the subject opened the reinforced side twice consecutively, the red heart was moved and the reinforced side changed. If the subject reached for the new reinforced side twice consecutively, the reinforced side was again changed. A successful first reach to the new side concluded the sequence. This, too, is a simple, clear procedure, interesting to most subjects this age. After trying candy, a grape, a piece of cracker and other reinforcements, the checker was found to be the most liked by the subjects, as well as the neatest to administer.

12/ Weisburg, Paul and Simmons, Mae W., "A Modified WGTA for Infants in their Second Year of Life," Journal of Psychology, 1966, 63, 99-104.

FINDINGS

The investigators are painfully aware of the difficulty and complexity of designing a set of conditioning tasks appropriate for each of four age periods with all the necessary control of variables, the design and construction of machinery and the search for reliable (preferably mechanical) methods of recording data. This initial project should be thought of primarily as a feasibility study rather than one which attempts to set up a finished methology and set of instruments. The data has not been tabulated or interpreted yet. Regarding feasibility, the experimenters made the following observations:

1. Administering a battery of four or five conditioning tasks to infants aged three through twelve months on three consecutive days is possible without unduly tiring the subjects.

2. Subjects of these ages present some unique problems. The physical setting and instrumentation so effective with helpless neonates are not likely to be tolerated by the older infant.

   a. He recognizes his mother and does not wish to have her leave. He is aware of strangers and the strange settings. He is not old enough to comprehend explanations. For example, in a Russian measurement of head turning with preschool children, the subject was coaxed to wear a helmet-like device because it " . . . was like Yuri Gagarin and the spacemen wear."13/

   b. The infant cannot be satisfactorily restrained in any position nor will he tolerate objects affixed to his body for measuring purposes. Many subjects could be tested without the mother present at 3 months and 6 months; very few at nine months could be tested without the mother; and only one out of 31 experimental and 10 control babies could be tested without

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13/ Brackbill, Yvonne and Koltsova, M. M., "Conditioning and Learning," in Infancy and Early Childhood, ed. by Yvonne Brackbill. New York: The Free Press, 1967, p. 237.

the mother in the room at 12 months of age. He dislikes being shut in a box, cubicle or other enclosed space, and fears unusual noises and machines. He tires easily and is often hungry or sleepy. At age three months the subjects usually slept and were fed at least once before completing a test period. He has lost most of his reflex responses but cannot yet manage tasks that involve problem solving or reasoning beyond the simpliest level. Tasks set up for the infant, therefore must be simple, pleasureable and brief. Intertrial intervals must be brief or he loses interest. Perceptiveness and flexibility on the part of the experimenter is essential at this age in order to sense and maximize the time when the infant is relatively calm and happy, i.e., testable.

3. The problem of acclimating the child to the strange setting was speeded by an initial play period with toys believed by the experimenters to be interesting to the particular age of the infant being tested. For some subjects acclimating, as evidence by smiling, babbling, handling objects, moving freely around the playpen or room, took much longer than for others. In an institutional setting this would not be a problem because the subjects would presumably feel "at home." On the other hand, few institutions offer a range of subjects encompassing all socioeconomic and educational levels and both races. (Our parents ranged in educational levels from faculty member with Ph.D. through business management down to fourth grade drop-out and institutionalized uneducable retardate. Socially they ranged from old-family socialite to fifteen-year old unwed mother.) Continued willingness to participate by parents is maximized by:

    Answering parents' questions about child development and child rearing philosophy, and in some cases referrals to proper help.
    Providing interesting pamphlets and magazine articles for parents to read.
    Providing transportation when necessary.
    Taking ample time to explain the purpose of the project and the importance of their participation.
    Avoiding long waiting periods as much as

possible by careful scheduling, but making it pleasant for the mother, infant and siblings when it was necessary.
Money payments were not necessary, even though the subjects included the illegitimate babies of four young and very low income mothers.

4. The bare room with a soft rug and a baffle wall concealing instrumentation was the best of the experimental layouts of those tried in this project.

5. These are the machines considered most satisfactory:

The one and two panel pressboxes
The WGTA
The attention-span box
Ring and cube discrimination apparatus

These were considered basically good in conception but needed further improvements:

The effort to duplicate the peering design as described by John Watson.
Enclosed cubicles
Objects attached to the head for measuring purposes
The eyeblink procedure
Mechanical measurement of the head turn

For other than detailed study of the eye blink response measurement by simple observation seemed to be more practical than measuring devices which entail affixing a small electrode or other object to the eyelid. Dr. Burton White expressed the opinion that for broad purposes, observation was adequate with this age group. The involuntary blink rate for infants is less than that for adults and, hence, presents less of a problem.

CONCLUSIONS

This study demonstrated that the conditioning behavior of a group of 31 subjects can be successfully studied longitudinally during the first year of life. A battery of 3-5 conditioning tasks can be designed which will be non-aversive to most infants and which can be administered over a three day period at quarterly intervals during the first year of life. An effort to relate conditionability to I.Q. and to the personality dimension of introversion-extroversion can be initiated by administering the Bayley Test of Mental and Motor Development at each quarterly testing period. This effort can not be concluded until the infants are old enough to be given standardized I.Q. and Personality Tests. Conditioning behavior can be related to attention span measurements taken at each test time. From among the many kinds of conditioning described in psychological literature the investigators used eye blink conditioning, head turn conditioning, vocalization conditioning, the push-panel and several kinds of discrimination problems as models. An attempt has been made to adapt or replicate instrumentation and procedures described in the existing literature. Conclusions have been drawn about the feasibility of each of the instruments and procedures at each age period. In addition, observations have been made about the feasibility of several kinds of test-room layout, time schedules, kinds of reinforcement, and general plan of organization of the research.

It is hoped that future research will polish and standardize some of the procedures and test instruments. It is conceivable that a standardized test battery for conditionability can be devised, including standardized instrumentation. Such a test might yield a score or Index of Conditionability. This score, properly interpreted to parents, could give valuable clues to the child's individual learning "style."

APPENDICES

Three Months

Day I	Day II	Day III
Vocalization	Vocalization	Vocalization
Attention span	Attention span	Attention span
Eye blink	Eye blink	Eye blink
Head turn	Head turn	Head turn
Discrimination task	Bayley Test	Bayley Test

Six Months

Day I	Day II	Day III
Vocalization		
Attention span	Attention span	Attention span
Cube discrimination	Cube discrimination	
Head turn	Head turn	Head turn
Eye blink	Eye blink	Eye blink
	Laugh response	Bayley Test
	Bayley Test	

Nine Months

Day I	Day II	Day III
Vocalization		
Attention span	Attention span	Attention span
Ring discrimination	One panel press box	Laughter
Eye blink	Eye blink	Eye blink
Head turn	Head turn	Head turn
	Bayley Test	Bayley Test

Twelve Months

Day I	Day II	Day III
Vocalization	Vocalization	Eyeblink
Attention span	Attention span	Head turn
Eye blink	Eye blink	Two panel press box
Head turn	Head turn	WGTA
	Two panel press box	Laughter
	Bayley Test	Bayley Test

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